

More than twenty-five years have elapsed since Mr. Welsh made his survey, and this was separated by an interval of twenty-one years from that which we owe to the joint labours of Sir Edward Sabine, Sir James Ross, and Mr. Fox. The instruments and methods of observation in 1858 were greatly superior to those of 1836-7, and hence a new survey made during the approaching period of minimum sun-spot disturbance, and on stations selected with careful reference to their geological character, would undoubtedly afford far more accurate data as to the absolute value of the magnetic elements and as to the extent of secular change in this part of the world than we at present possess.

VI. "On the Circulation of Air observed in Kundt's Tubes, and on some Allied Acoustical Problems." By LORD RAYLEIGH, D.C.L., F.R.S. Received October 23, 1883.

(Abstract.)

Experimenters in acoustics have discovered more than one set of phenomena apparently depending for their explanation upon the existence of regular currents of air, resulting from vibratory motion, of which theory has as yet rendered no account. This is not, perhaps, a matter for surprise, when we consider that such currents, involving as they do *circulation* of the fluid, could not arise in the absence of friction, however great the extent of vibration. And even when we are prepared to include in our investigations the influence of friction, by which the motion of fluid in the neighbourhood of solid bodies may be greatly modified, we have no chance of reaching an explanation, if, as is usual, we limit ourselves to the supposition of infinitely small motion and neglect the squares and higher powers of the mathematical symbols by which it is expressed.

In the present paper three problems of this kind are considered, two of which are illustrative of phenomena observed by Faraday.\* In these problems the fluid may be treated as incompressible. The more important of them relates to the currents generated over a vibrating plate, arranged as in Chladni's experiments. It was discovered by Savart that very fine powder does not collect itself at the nodal lines as does sand in the production of Chladni's figures, but gathers itself into a cloud, which, after hovering for a time, settles itself over the places of maximum vibration. This was traced by Faraday to the action of currents of air, rising from the plate at the places of maximum vibration, and falling back to it at the nodes. In

\* "On a Peculiar Class of Acoustical Figures; and on certain Forms assumed by Groups of Particles upon Vibrating Elastic Surfaces." "Phil. Trans.," 1831, p. 299.

a vacuum the phenomena observed by Savart do not take place, all kinds of powder collecting at the nodes. In the investigation of this, as of the other problems, the motion is supposed to take place in two dimensions.

It is probable that the colour phenomena observed by Sedley Taylor\* on liquid films under the action of sonorous vibrations are to be referred to the operation of the aerial vortices here investigated. In a memoir on the colours of the soap-bubble,† Brewster has described the peculiar arrangements of colour accompanied by whirling motions caused by the impact of a gentle current of air. In Mr. Taylor's experiments the film probably divides itself into vibrating sections, associated with which will be aerial vortices reacting laterally upon the film.

The third problem relates to the air-currents observed by Dvorak in a Kundt's tube, to which is apparently due the formation of the dust figures. In this case we are obliged to take into account the compressibility of the fluid.

VII. "The Influence of Bodily Labour upon the Discharge of Nitrogen." By W. NORTH, B.A., F.C.S. Communicated by Professor J. S. BURDON SANDERSON, F.R.S. Received October 29, 1883.

(Abstract.)

The scope of this inquiry has been strictly limited to one question, viz., that of the influence of labour in modifying the normal relation between food and excreta. No attempt has been made to investigate the *mode* in which nitrogenous products come into existence in the organism.

The researches immediately bearing on the subject of this paper are those of Dr. Parkes ("Proc. Roy. Soc.," vols. 16 and 21), and those of Dr. Austin Flint, made on the pedestrian Weston ("New York Med. Journal," June, 1871). Dr. Parkes found that bodily exercise caused a slight increase in the nitrogen discharge during or immediately after labour. The increase was, however, so inconsiderable that it may well be questioned whether it could not be accounted for as dependent on the more perfect absorption of food; for although the diet of the soldiers experimented upon was carefully regulated, and the nitrogen it contained determined by analysis, with the result that before work the quantity of nitrogen taken in considerably exceeded the quantity discharged, the two became practically equal during the work period. Consequently if the whole period of observation is

\* "Proc. Roy. Soc.," 1873.

† "Edinburgh Transactions," 1866-67.